

**The Mystery of
Lyle and Louise**

Strands of Evidence

A Lab on Hair and Fiber Analysis



Hair and Fiber Analysis

PHYSICAL evidence results from the transfer of small quantities of material – such as hair, paint chips, glass fragments, gun shot residue, etc. – from one source to another and is most often used to shed light on the events of a crime rather than to positively identify a criminal. Physical evidence can be classified into two categories:

- **Individual characteristics:** those that identify a single source, like DNA
- **Class characteristics:** those that are associated with a particular characteristic but not necessarily an individual, such as blood type.

The exchange of physical evidence was first described by Sir Edmond Locard. Locard's principle states that "with contact between two items, there will be an exchange." When a crime is committed, material will be mutually exchanged between the perpetrator and the crime scene. Given this principle that "every contact leaves a trace," it is up to the investigator to identify materials that are seemingly foreign to the location.

The amount of physical (or "trace") evidence transferred depends on the nature and duration of contact, as well as the type of contacting surfaces. Trace evidence transfer is more likely to be found in intimate, brutal crimes occurring over a long period of time than in the case of less forceful and intimate encounters.

Because of the transient nature of trace evidence, investigators must take care with collection and preservation. Additionally, investigators could introduce, through secondary transfer, extra trace materials into a crime scene which could contaminate evidence. Equal caution must be taken to avoid inadvertently removing or destroying trace materials from the crime scene. As time passes after the completion of a crime the likelihood of evidence becoming lost increases. To prevent contamination or loss concerns, "elimination standards" are often collected from crime scene personnel and used to exclude them as the source of evidence. First, large evidence should be collected during a careful walk-through of the scene. Next, trace evidence should

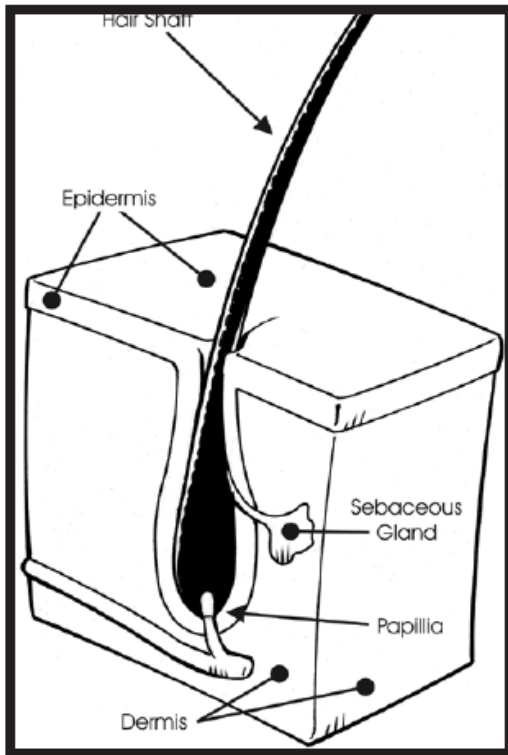
be collected before, finally, the scene is processed for other types of evidence, such as fingerprints and biological evidence. This procedure ensures that the most evidence possible will be preserved, rather than destroyed, during the investigation.

Trace evidence, as the name implies, can include many small quantities of contact-associated items. The two most common types recovered at a scene are hairs and fibers, an association that seems natural given the amount of these types of materials encountered in daily life. Whether combing hair, sitting on a carpet or rug, or brushing against a household pet, hair and fibers are constantly exchanged through normal, day-to-day interaction. The discovery of hair evidence at a crime scene could place a suspect in an area they deny having been in. The type, condition, and number of hairs found at a scene all contribute to their value in a criminal investigation.

Hairs are comprised of the protein keratin and grow outward from follicles in the skin of mammals. Hair undergoes two main life stages: the anagen and telogen phases. The anagen phase is the active growth phase, while the telogen phase is a dormant phase, during which growth ceases. The telogen phase produces the majority of the evidentiary material since most hairs found at a crime scene are naturally shed. Anagen and telogen hairs can be distinguished by examining the root sheath, as telogen hairs have characteristic club-shaped roots, while anagen hairs show stretching of the root area due to the mechanical force required to remove them from the follicle. The damaged root of an anagen hair is important, as it suggests that force was used to remove it and can indicate violence.

The root sheath is the base from which the hair shaft grows. DNA can be obtained from the roots of hair, which may contain up to 100,000 cells, however obtaining DNA from the shaft of hair is often difficult. Hair shafts contain three layers: the medulla (inner), cortex (middle), and cuticle (outer) layers. The cuticle is translucent and contains scale patterns that cover the shaft, and these scale patterns

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can be used to define the species of mammal that shed the hair. There are three basic scale patterns: coronal (crown-like), spinous (petal-like), and imbricate (flattened). Human hairs usually have the imbricate scale pattern, therefore, when an investigator identifies a hair containing a coronal or spinous pattern, the likely deduction is that the hair was not shed by a human.

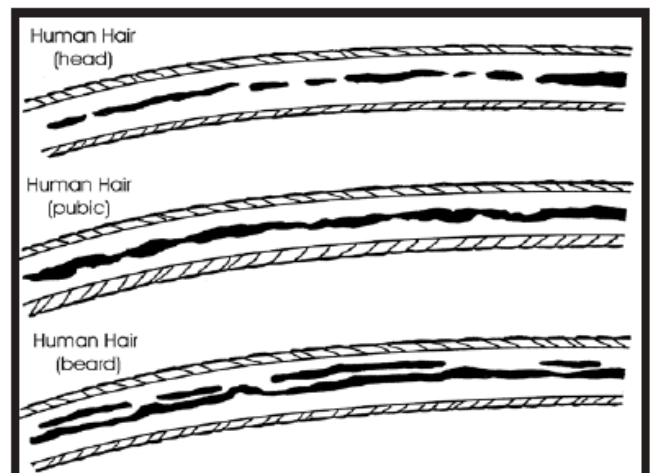
Trace analysts use “scale casting” techniques to identify hairs as either human or animal. A cast of the scale pattern on a hair is made and examined under a microscope at a range of magnification between 40X and 400X. One of three techniques is commonly used to make a scale cast. In the first method, a Polaroid film-coater may be used to apply a thin layer to a glass microscope slide. A hair specimen is then pressed into the film and allowed to dry. When the hair is removed, the cast remains, and this scale pattern is then analyzed under the microscope to classify the hair. Clear tape, in combination with a slide cover slip, can also be used as a mounting medium to provide a second, quick meth-

od to observe surface scales of hair. Lastly, clear nail polish may be painted onto a microscope slide and used in a similar way to the Polaroid film-coater. Once the hair has set in the medium and the polish has dried, the hair can be removed, and the scale pattern from the cuticle will remain in the cast.

The cortex layer of the hair shaft is the main body of the hair and is made of elongated, spindle-shaped (fusiform) cells. Additional identifiers, such as pigment granules (small, dark, solid structures), ovoid bodies (solid, spherical structures), or irregular air-spaces (cortical fusi), may also be observed.

The medulla, the central core of the hair shaft, often indicates whether a hair was shed from a human or animal. The medulla of a human hair is poorly defined, broken, or even absent, while animal medullas are well defined and continuous.

Forensic scientists have developed a statistic called the medullary index that can be used to determine if a hair is of human or animal origin. The medullary index is calculated by measuring the width of the medulla and dividing it by the total diameter of the hair shaft. Usually, human hairs have a medullary width that is less than one-third of the diameter of the hair (approximately 0.3), while animal hairs have larger medulla and medullary indices greater than 0.5, indicating that the medulla is at least half as wide as the total diameter of the hair shaft. In certain instances, these medullary indices



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may even be used to differentiate between species of animals.

Hair, in both humans and animals, is influenced by which body region it grows in. These differing characteristics may be used to determine the hair's origin on the body. In humans, while it is possible to identify chest, arm pit (axillary), or limb hairs, they are rarely recovered as evidence at a crime scene. The primary types of human hair used in forensic investigations come from either the scalp (head) or pubic regions. Scalp hairs are generally longer with a moderate shaft diameter; the medulla in human head hair ranges from completely absent to continuous and is narrow in comparison to hairs from other portions of the body. Pubic hairs are more coarse and wiry, often exhibit characteristic "buckling" of the shaft, and frequently have broad, continuous medullas throughout.

The structure of animal hair is often dependent on the hair's function. Guard hairs form an outer coat of many animals, providing protection, while the fur or wool hairs of the inner coat provide insulation. Additionally, the tactile hairs or whiskers are used as sensory devices.

Furthermore, scalp hairs frequently show characteristics from grooming, such as artificial coloring, bleaching, or tips that are cut or split. Hairs generally grow one half-inch per month, therefore hairs may give an investigator the opportunity to measure the amount of time between an event (such as dyeing of hair) and the time the hair was left at a scene.

In addition to identifying a hair's original location on the body and differentiating human from animal hairs, human hairs can be classified into three ethnic or racial categories: European origin (Caucasian), African origin (Negroid), or Asian/Native American origin (Mongoloid). European origin hairs normally have moderate shaft diameters (~80 μm) with minimal variation and pigment granules ranging from sparse in number to densely packed that occur at even intervals. If these hairs are cut, cross-sectional views reveal oval shapes. African

origin hairs have a wide range of shaft diameters, from moderate to fine, and the shafts of these hairs have prominent twisting and curling with pigment granules densely distributed throughout. This dense pigmentation gives the hairs an opaque appearance when viewed through a microscope. The cross-sectional shape of these hairs is flattened. Asian origin hairs have coarse shaft diameters with little variation, densely distributed pigment granules arranged in patchy areas or streaks, broad and continuous medullas, thick cuticles, and round cross-sectional shapes.

Hair comparisons do not provide absolute identification. A trace evidence examiner, however, can reach one of three basic conclusions from hair comparisons:

1. Hairs from the suspect or known source have the same microscopic characteristics as the evidence, and these samples can be associated with one another.
2. Hairs from the evidence are microscopically different from the hairs from the known suspect or source, and these samples cannot be associated with one another.
3. Hairs from evidence have some characteristics that match and some that do not match the known suspects or standards, therefore no conclusion can be drawn as to whether the samples are from the same source.

When reaching these conclusions, an analyst should limit the report to only factual items and not interpretations. Interpretations of evidence and its relationship to a crime should be left for court testimony.

Fibers are the smallest unit of textile material and can be from natural or synthetic sources. Like hair, textile fibers are often exchanged between individuals and objects, and comparison of fibers found at a crime scene with those obtained as standards may support or refute statements from both witnesses and suspects. Matching a fiber found on a suspect with one that was obtained during the investiga-

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tion of a crime scene is often very compelling evidence, as it places a suspect at the crime scene. The value of a fiber match depends on the association between unknown fibers and known standards – features such as color variation, type, location, and number of fibers found. The number of differing types of fibers found is also critical. For example, three different fiber types matching between suspect and crime scene is stronger evidence than only a single match.

The type and length of fiber, the method used during manufacture to combine the fibers, and the type of fabric construction all impact the transfer of fibers and the significance of their matches. Additionally, the overall condition of the garment also affects the likelihood of fiber transfer. The length and intimacy of contact and the mobility of the object or people coming into contact with one another also affect the amount of fibers transferred. For example, a person merely sitting on a rug will not pick up as much evidence as one rolling around on the rug.

The overall condition of a garment and whether it is made of natural or synthetic fibers contributes to the ease at which fibers are deposited at a scene. Both newer fabrics and older fabrics may increase the likelihood of shedding fibers, as new fabrics have an abundance of loosely adhering fibers and older fabrics often have damaged areas which are prone to shedding. In addition, color-fading and discoloration due to staining may allow a trace examiner to match evidence fibers to a source.

Both plant or animal fibers are commonly used to

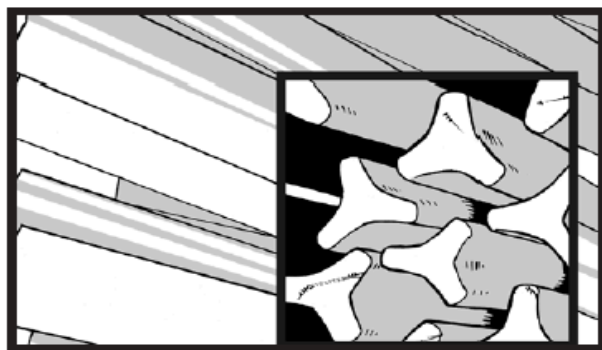
make fabric, and a given fiber will possess a number of individual characters, defined as qualities or features, that distinguishes one fiber from another. These characters include the fiber's source, length, and degree of twist, as well as the processing techniques and color additives used during manufacturing. These individual characters, when taken together, may produce a complex profile of the questioned fabric.

The most commonly used animal fiber in textile manufacturing is wool. Wool fibers come from sheep and can vary in coarseness, which influences the way it will be used in textiles. Finer woolen fibers are used in the production of clothing, while coarser fibers are often reserved for the production of carpet.

The most abundant plant fiber used is cotton. Because wool and cotton fibers are so common, the manufacturing characters (color, twist, weave) add significance to any matches when they are analyzed. Less common plant fibers include flax, jute, and hemp, and less common animal fibers include alpaca, camel, cashmere, and mohair. These fibers offer a trace analyst increased significance and ease of match due to their relative rarity.

The majority of fibers used in textile manufacturing are synthetic, or man-made. Some synthetic fibers are actually generated from natural materials, such as cotton, while others are completely synthetic. Examples of man-made fibers are polyester, nylon, acrylic, rayon, and acetates — listed from most to least common. Again, the rarer the fiber, the more significant a match association becomes.

In processing a fiber, cross-sectional analysis is often required to make a match. Cross-sectional shapes can identify a fiber type that may have only been produced for a short period of time, and these cross-sectional shapes increase the significance of matching that type of fiber to a crime scene. For example, most carpet fibers exhibit a characteristic tri-lobal cross-section and can, therefore, be easily identified using this technique. As with natural-made fibers, the color of man-made fibers plays a



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role in the significance of a match. Often manufacturing companies use specific color combinations to dye materials, and matching these unique colors with a fiber found at a crime scene can allow a trace analyst to determine the origin of the fiber.

Determining the significance of a similar fiber being found at a crime scene and on a suspect's clothing is a combination of evaluating the fiber's defining characters with the likelihood that the fibers could have been deposited on either location at random. Finding multiple types of fibers on both suspect and at the scene increases the likelihood that this did not occur by chance alone. Therefore, the argument that the same fibers are found at both places through coincidence is less convincing to a jury. In addition to multiple types of fibers, cross transfer of evidence is also highly significant. Cross-transfer occurs when hair or fibers are exchanged between both the suspect and crime scene; that is, the suspect leaves some fibers behind, while taking some fibers away, from the scene. Such an exchange reduces the likelihood of a coincidence and increases the significance of the findings

Because fibers are considered class, and not individual, evidence, reporting matches between fibers must be done with great caution. For example, if a trace analyst has included a garment as the source of a fiber found at a crime scene and the garment is not one-of-a-kind, the analyst must qualify the match by stating the fiber is "consistent with" those originating from the clothing item. This qualification does not mean the match is without significance, but merely that unique identification of the source material is not possible.

Both hair and fiber analyses are skilled judgments that require technical ability and broad knowledge of materials and manufacturing methods. These comparisons are somewhat subjective in nature and require a trace analyst to develop advanced critical thinking skills. The systematic, and often tedious, comparison of hairs and fibers can result in more questions than answers and more leads than conclusions. It is for this reason that trace analysts

must weigh evidence, and rule out coincidence, when processing these important clues.

A trace evidence analyst, generally, has a bachelor's degree in a natural science, such as chemistry, with a strong background in microscopy, analytical instrumentation, and photography. Newly hired analysts must complete a very extensive training period under a senior examiner before they begin performing independent casework. A trace analyst uses a variety of instrumentation and visualization tools in their analysis of evidence, including stereoscopic microscopy, polarized light microscopy (PLM), ultraviolet light microscopy, scanning electron microscopy, Fourier Transform infrared spectroscopy (FTIR), gas chromatography / mass spectrometry (GC/MS), pyrolysis gas chromatography, ion chromatography, and microspectrophotometry.

Additional Reading

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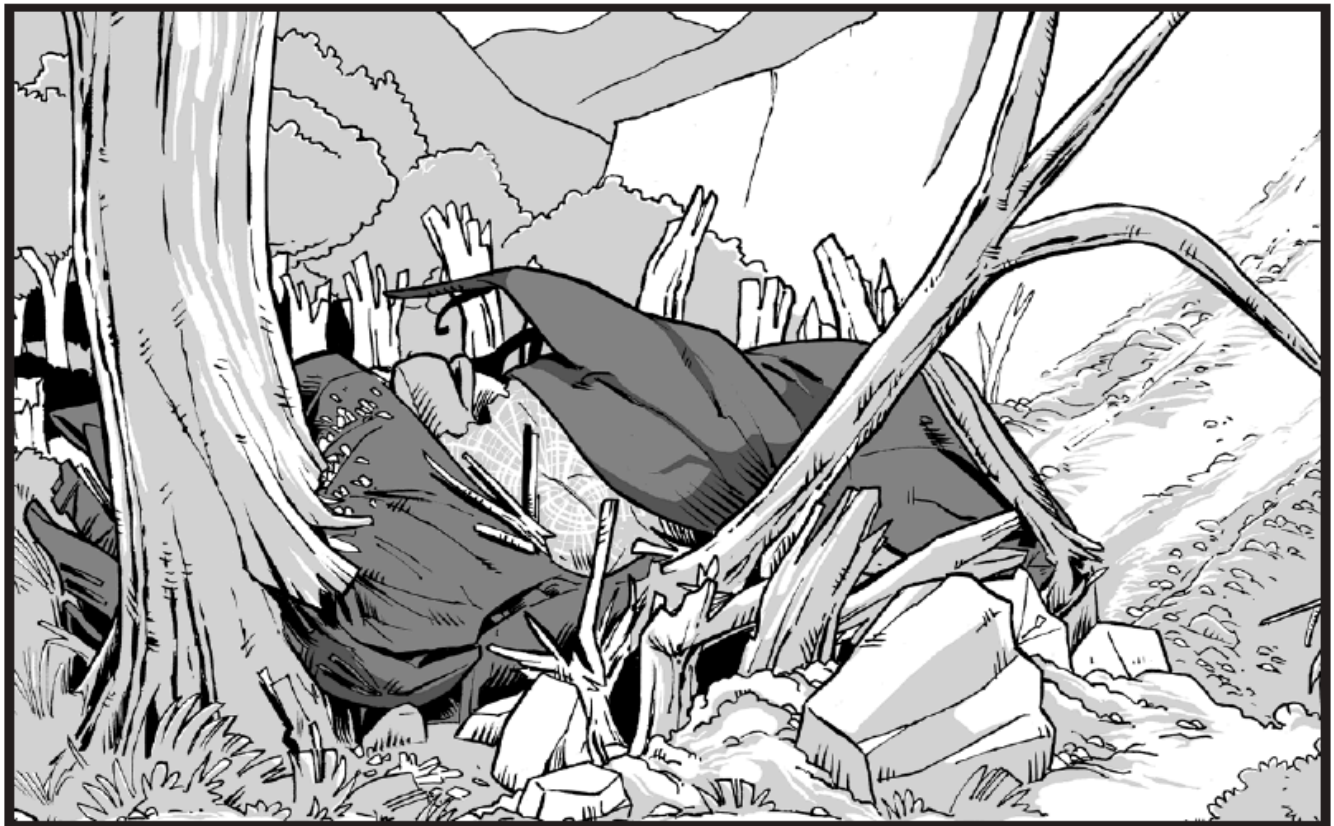
The Investigation

NINE days ago, during the night of a sudden summer thunderstorm, the Mondelo family car went over the side of Backbone Mountain and caught fire on impact. Three bodies were found in the wreckage; an adult woman, a teenage male, and a female child. All were burned beyond recognition. The three victims were identified as Louise Mondelo and her children, Wally and Jan, by personal effects that survived the fire.

Pictures of the scene were recorded but, due to the rainstorm, the crash was initially believed to be simply a tragic accident and was not treated as a crime scene. When Lyle Mondelo could not be reached and was found to be missing, he became a possible suspect, and the wreckage was thoroughly processed. The scene was substantially disturbed and some evidence was undoubtedly lost however, upon retracing the path of the vehicle, investigators found several pieces of broken glass lying in the roadway. Becoming increasingly more suspicious of

foul-play, the broken glass fragments were packaged and retained. In addition, investigators cut and removed a section of charred carpet from the vehicle for further laboratory analysis. The bodies, as part of an ongoing criminal investigation, were kept in the county morgue.

The small town of Highland Park was shocked, since nothing this terrible had ever happened in the area. Tips from neighbors and friends poured into the police department, but none of the tips were eyewitness accounts or provided specific information regarding the car accident. Lyle was the likely suspect but was nowhere to be found. An all-points bulletin was issued for everyone to be on the lookout for Lyle Mondelo. He was presumed armed and dangerous and to be driving a missing, blue, 1993 Ford Ranger with Tumbling Water Land Development Co. logos. Four days ago, Lyle Mondelo's credit card was used to purchase gasoline and food at a gas station in Texas.



The Investigation

When contacted, business associate John Wayne Gretzky told investigators that Lyle had been slipping into a deep depression because of trouble at their jointly owned business, Tumbling Water Land Development Company. Gretzky also hinted that there had been problems in the Mondelo family. At this time, investigators noticed that John had a large bite mark on his upper arm. When asked about the wound, Gretzky claimed to have been bit during a bar fight the night before and allowed the bite to be photographed. He was not held or charged with any crime.

Background Investigation

With no additional leads, police launched a full investigation into the Mondelos. Louise Wilson and Lyle Mondelo had met at college while receiving Business Degrees in Management. They married in college and moved to Highland Park, Louise's hometown, after graduation. The town was still ailing at the time, suffering from the shut down of the mines a little over a decade ago. Although at first Lyle thought their business prospects in the small town were poor, he soon discovered that money could be made developing land for the private lodges and ski resorts that employed most of the residents.

After returning to Highland Park, Louise ran into her old high school sweet heart, John Wayne Gretzky. While talking to him, Louise learned that he was also a developer. Glad to see an old friend, and thinking that a favorable business relationship could develop, Louise asked John to meet with her and Lyle over dinner. Lyle and John soon became friends, and rather than compete for business against each other, the three decided to join together and start Tumbling Water Land Development Company.

A year after Tumbling Water was founded, Louise conceived her first child, Wally. Friends of the Mondelos said that Lyle suspected Louise and John of having an affair at the time, and the two nearly divorced. The couple worked out their relationship with the help of a marriage counselor.

Tumbling Water became prosperous and was able

to buy several hundred acres of land adjacent to Blackrock River, a prime recreational waterway. Soon thereafter, Louise had another child, Jan, and took leave from the office to work from home while she raised the two children. Friends say that Louise never really went back to Tumbling Water, even after the children were older and in school. Their friends also suggested that Lyle and Louise's relationship was healthier with them not working together.

Tumbling Waters' lawyer told investigators that she began preparing bankruptcy papers for the company about a year ago; the ski resort was dragging out negotiations for a property purchase, and the company's other business deals weren't making enough profit to keep the business afloat. Soon after being asked to begin the bankruptcy filing, though, she said an unexpected deal was made to build a number of fishing cabins on the Blackrock River land. That was enough to keep the business going, and after that, Tumbling Water began making deals at a steady rate.

A potentially related case recently touched on the Mondelos' lives. Three weeks ago, a crystal methamphetamine lab was discovered in an abandoned camper on Tumbling Water land. Louise's nephew, Mitch Wilson, and John Wayne's brother, Larry Gretzky, were found in the lab and indicted for possession with intent to sell the 6 kilograms of meth found in the lab. Two days later they were both released on bond, posted by Lyle Mondelo and John Gretzky. Mitch and Larry gave no names of possible suppliers or dealers.

Two weeks before the crash, Louise Mondelo filed for divorce. Friends say she told them that she suspected Lyle of being involved with drugs, but that the friends believed she was involved with John Wayne Gretzky again. Two days later after filing for divorce, Louise requested a restraining order against Lyle, stating that Lyle had harassed her and the children. Louise also told police that she was afraid that Lyle might try to take the children away.

When attempting to contact Mitch Wilson and Lar

The Investigation

ry Gretzky for questioning about the car accident, police discovered that they had both skipped town along with Larry's girlfriend, Mary Bradey. Authorities believed that their disappearance could be related to the accident, and they were described as possibly armed and dangerous in the warrant posted for their arrest.

Two days ago, an abandoned blue Ford Ranger with out-of-state plates was found on a strip of New Mexico highway. The pickup was dirty and a headlight was broken, but investigators noticed a Tumbling Water Land Development Co. sign on the back tailgate. Forced entry was apparent. Upon access to the truck, investigators discovered several pieces of trace evidence and sent it to Highland Park for analysis.

At the Scene

This morning the bodies of two deceased victims were discovered in a remote fishing cabin on property owned by Tumbling Water Land Development Company. The cabin, isolated from view of the main road and deeply buried in the thick woods, lies along the bank of the Blackrock River and is accessible only by a gravel road cutting into the forest. Soon after the bodies were discovered, the small cabin was surrounded by police tape and investigators combing the scene in search of evidence.

Detective Murray, the lead investigator in the case, explained, "A Girl Scout on a hiking trip found the victims about an hour and a half ago. There are two bodies inside, both in advanced stages of decomp; PMI undetermined. The female vic



was identified as Louise Mondelo, the same woman identified in the car that ran off Backbone Mountain and caught fire during the storm last weekend. The bodies are in bad shape, but hopefully we'll get a positive ID when DNA analysis comes back."

Inside the cabin the smell of advanced human decay was overwhelming. The overturned chairs and tables led investigators to conclude that a violent struggle had taken place. The smaller body, dressed in a blouse and jeans, was found near the phone in the kitchen. The larger corpse was dressed in a man's polo shirt and slacks lying in the corner to the left of the door, and blood covered the walls and floor around him. Investigators collected maggots from the corpses to help establish a time of death and collected DNA samples from both victims. While processing the scene, flesh was discovered scraped across the stone of the fireplace, and blood and skin were found on a piece of firewood lying near the woman's body. Samples of both were collected for analysis. The wounds upon the head of the female victim appeared consistent with the firewood, but a definitive determination was difficult to make due to the state of decay. Outside of the cabin, a set of tire tracks were found deeply rutted in the mud and grass. As none of the investigators had driven near that area, dental stone molds were cast of the tracks and pictures were taken to preserve evidence.

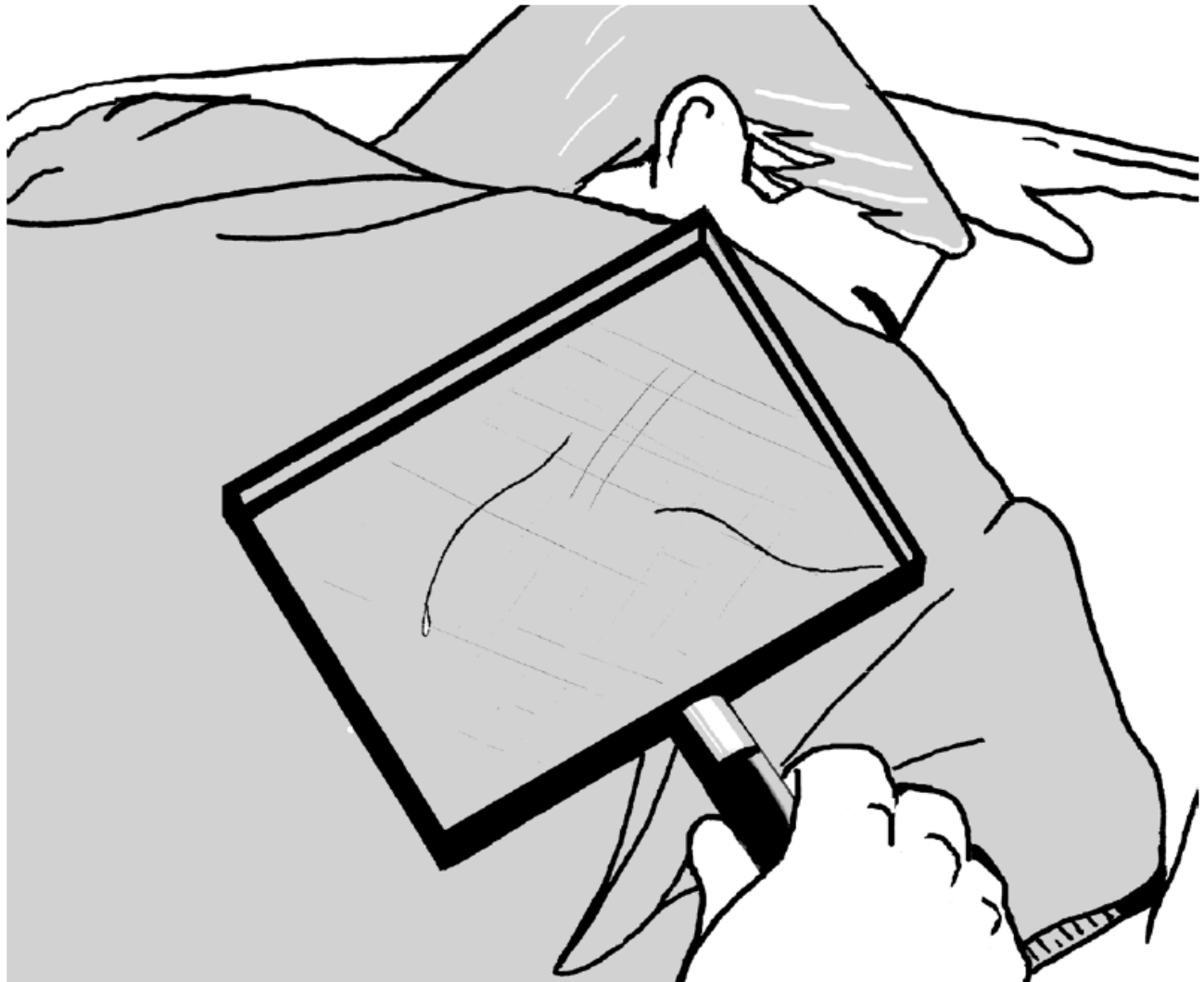
The Evidence

Recently, authorities in New Mexico discovered a truck with the Tumbling Water Land Development Co. logo on the side out of gas and abandoned on the side of the highway. In the back of the cab, they discovered a bloody blanket, from which they used tape lifts to recover hair and fiber evidence. The fiber collection tape was mailed to Highland Park authorities in sealed evidence bags.

Additionally, hair and fiber evidence was also recovered by Highland Park authorities during the investigation of the double homicide in the fishing cabin near Blackrock River.

Furthermore, hair exemplars obtained from both Larry Gretzky and Mitch Wilson have just arrived from New Mexico where the two were apprehended yesterday while hitchhiking south, presumably trying to reach Mexico. When a uniformed officer in a patrol vehicle pulled up and offered help, the two panicked giving themselves away to the officer, who radioed dispatch to check for outstanding warrants.

New Mexico authorities collected and overnight shipped evidence from the two suspects to Highland Park for processing.



Persons of Interest

The Mondelos

Louise Ann Mondelo, the 38 year old wife of Lyle Mondelo and mother of Wally and Jan, is also one of the owners of Tumbling Water Land Development Company. Friends say that Louise was in an unhappy marriage and had recently filed for divorce.

Lyle Christopher Mondelo, the 40 year old husband of Louise Mondelo and father of Wally and Jan, is a part owner of Tumbling Water Land Development Company along with his wife.



John Wayne Gretzky

John Wayne Gretzky is 41 years old. He is a friend and business partner of the Mondelo's in the Tumbling Water Land Development Company. According to rumors, John Wayne and Louise had a brief affair when Lyle and Louise first moved to Highland Park. He is known around town to be a greedy businessman, and has been suspected of shady deals in the past.



Larry Gretzky and Mitch Wilson

Larry Gretzky and Mitch Wilson were recently indicted on charges related to their apparent operation of a methamphetamine laboratory. Larry was bailed out by his brother, John Wayne, and Mitch was bailed out by his uncle, Lyle Mondelo. Larry and Mitch failed to appear in court and are currently missing. Police are interested in locating them for questioning.



Pre-Lab Questions

Background

1. What are the two categories into which physical evidence is classified?

2. What is the medullary index and why is it important?

3. What are some useful features of a fiber to use when examining the trace evidence?

4. What are the most common natural and synthetic fibers?

5. Why should an examiner be very cautious about reporting matches between fibers?

Procedure

6. What two things will be on the finished slide?

7. How should you label your slides?

8. What is the source of the hairs and fibers on the collection tape?

9. To what are you comparing those hairs and fibers?

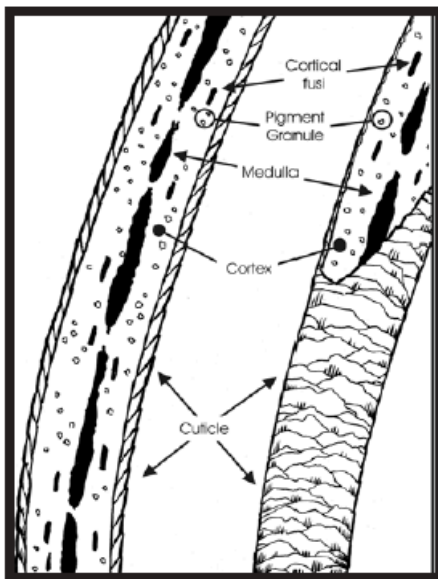
10. How should a possible match be determined?

Hair and Fiber Identification

1

The strand has multiple structures, including a cortex and cuticle:

Hairs



The strand has no discernible structures:
Fibers

2

The medulla is absent, or less than 1/3 the diameter of the hair:

Human

The medulla is evident and greater than 1/3 the diameter of the hair:

Animals



3

The medulla is segmented, and the cuticle has overlapping scales:

Cat

The medulla is solid, the cuticle smooth, and cortical fusi are evident:

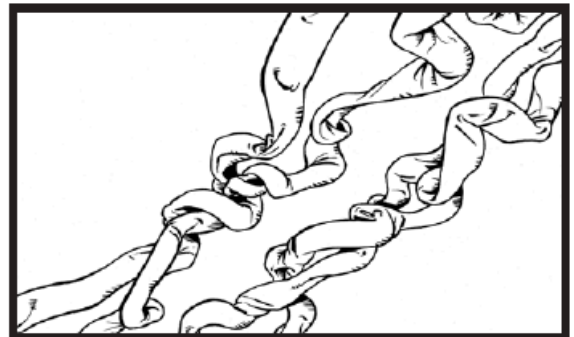
Dog



4

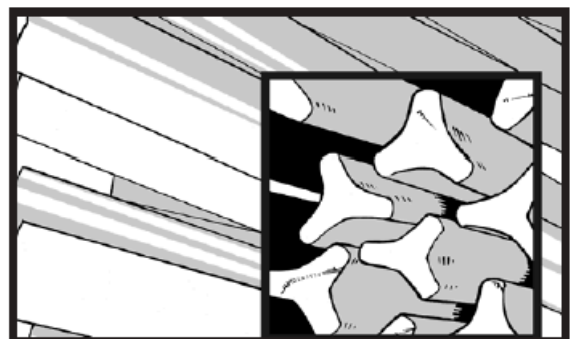
Fiber has a lateral twist, as in the first image below:

Cotton



Fiber is tri-lobal, as in the bottom image:

Carpet



Lab Procedure

Removing Fibers from Collection Tape

1. Place the hair and fiber collection tape into a beaker with approximately 400 mL of water. The evidence from this tape was collected from the truck found in New Mexico.
2. Gently agitate the tape to dissolve the adhesive.
3. When the fibers have detached from the tape, filter the water. Your instructor will demonstrate the use of filters and filter paper.
4. Remove the filter paper and set it aside to dry.

Preparing the Slide

1. Paint a small circle of casting medium onto the microscope slide slightly to the right of center.
2. Wait approximately 20-30s for the medium to begin to harden.
3. Tweeze a hair or fiber from the filter paper and place it into the casting medium. Ensure at least one end is not in the medium.
4. Wait a few moments for the medium to harden slightly.
5. Before the medium has fully hardened, gently tweeze the strand out of the medium. A cast impression of the fiber should remain.
6. Paint a very small amount of casting medium 1 to 2 cm to the left of the impression.
7. Place the strand into this drop of casting medium. The casting medium will act as a glue to permanently attach the strand to the slide.
8. Carefully place a cover slip over the strand and drop of medium. Press gently on the slip to ensure the coverslip seals completely.
9. Repeat this process until your lab group has mounted ten samples from the collection tape.

Sample Characterization

1. Place a sample onto the microscope stage. Adjust and focus the scope to examine the mount-

ed strand.

2. Using Step 1 on the handout Hair and Fiber Identification, determine whether your sample is a hair or a fiber.
3. Choose the appropriate RED data collection sheet for your sample, depending on whether it is a hair or a fiber.
4. Continue to use the handout to fill in all of the spaces on the data collection sheet.
5. Adjust your microscope to analyze the cast you prepared of the outside of the hair or fiber.
6. Sketch the observed cast features on your data collection sheet.
7. With a permanent marker, label this slide with the sample identification code located on the data collection sheet you are using for this sample.

Entering Samples into Evidence

1. Your instructor will have a space to enter samples into evidence. There will be different places to enter human hairs, animal hairs, and textile fibers.
2. For each of your samples, copy the information required from your data collection sheet onto the red truck evidence sheet. Ensure that your sample's identification code is recorded.
3. Place your data collection sheet and labeled slides into evidence.

Sample Comparison

1. Select a bag of evidence collected at the murder scene and remove the included strand.
2. Create a cast and mount of the evidence from that envelope on a microscope slide in the same fashion as with the samples removed from the evidence tape.
3. Choose an appropriate GREEN data collection sheet, depending on whether your sample is a hair or a fiber.

Lab Procedure

4. Characterize the sample utilizing the same method used for those collected from the truck and record your findings and sketches on your data collection sheet.
5. Refer to the red truck evidence sheet, and determine if any of the samples previously entered have descriptions similar to the current sample.
6. If no similar samples are found, record your current sample on the No Match sheet provided by your instructor. Proceed with step fifteen.
7. If a sample that appears similar is found, collect that sample's data collection sheet and slide.
8. Check this sample out of evidence by putting its identification code, your initials, and the check-out time on the evidence check out sheet.
9. Microscopically compare the two samples. Visually determine if the sample collected at the cabin is a potential match to the sample collected in the truck.
10. Allow another member of your lab group to examine the two samples.
11. If both group members agree that the samples are consistent with one another, record these samples on the possible matches sheet.
12. Check the truck sample back into evidence.
13. If multiple samples from the truck are potential matches, record all samples on the same line of the sheet.
14. Record your sample's information on the green cabin evidence sheet and place the sample collected from the cabin into evidence.
15. Perform this process for all samples collected at the cabin.

Suspect Collections

1. Select an envelope of evidence obtained from one of the suspects, Larry Gretzky or Mitch Wilson.
2. Analyze those samples using the previously utilized analytical procedure for those samples collected at the cabin with the following changes:
 - BLUE data collection sheets should be utilized for suspect samples.
 - When attempting to identify similar samples in step six, compare these samples to both those from the truck and those from the cabin.
3. Repeat this procedure until all suspect evidence has been processed by the class.

Post-Lab Questions

Truck Collections

1. How many distinct types of hair and fiber did your lab group recover from the collection tape?

2. How many distinct types of hair and fiber did the class as a whole recover from the collection tape?

3. Considering your responses to the previous two questions, what conclusions about sampling can you draw?

Evidence Handling

4. Why do you believe the samples were sealed in the manner they were?

5. What reasons can you think of to keep the two collections separate?

Evidence Comparison

6. How many distinct types of hair and fiber were matched from the cabin collections to samples recovered from the Truck (on the collection tape)?

7. What characters did you rely on when determining if samples were a possible match?

8. What can you say about the likelihood of the blanket from the truck being in proximity to the cabin? Can you express this as a percent? If so, to what precision? Justify your response.

